AFCI Systems Analysis Overview

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Outline

- *Systems Analysis Activities in FY 03*
- *MIT Report on the Future of Nuclear Energy*
- *Changes in the AFCI*
- *Systems Analysis Activities in FY 04 and beyond*

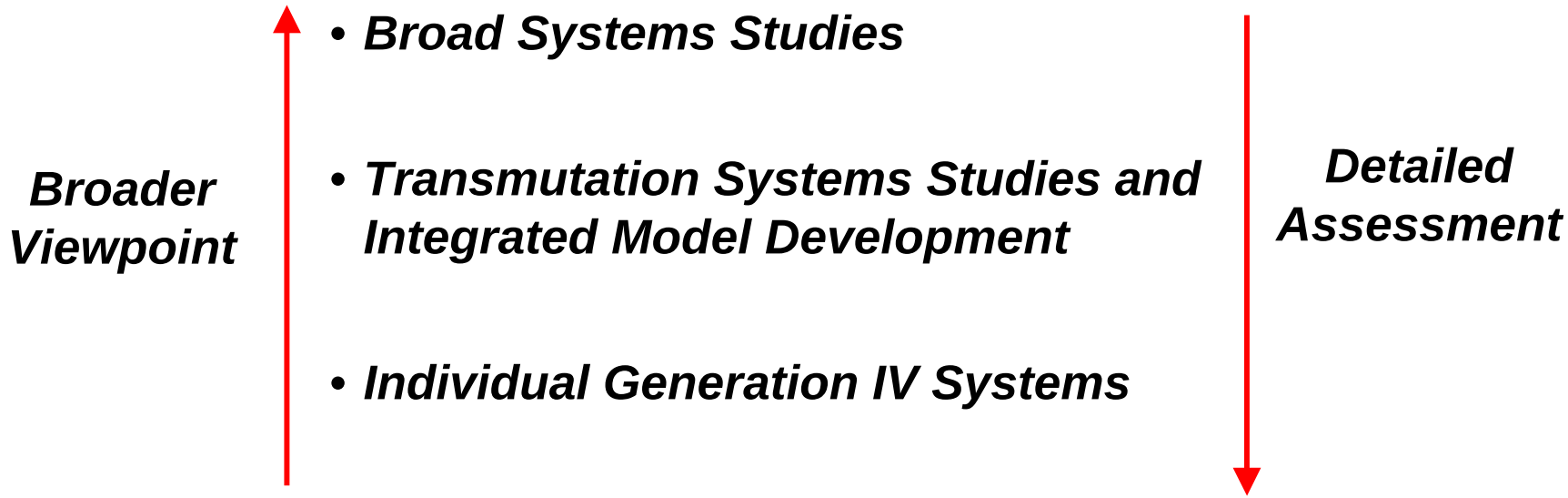
Questions for Systems Analysis

For an Advanced Fuel Cycle in the U.S.:

- ***What are the overall benefits?***
  - ***Optimize the use of the first repository***
  - ***Reduce the need for, or avoid a second repository***
  - ***Remove long-term barriers to construction of NPPs***
  - ***Improve energy security and sustainability***
- ***What is needed (technology, facilities, capabilities) to achieve the benefits?***
- ***What schedule is needed to achieve the benefits?***
- ***What analyses and engineering data are needed to support a decision on the second repository before December 2007*?***

- ***(*statutory date: January 1, 2010)***

Systems Analysis Hierarchy



Systems Analysis in FY 2003

AFCI Activities:

- ***AFCI Report to Congress issued in January 2003***
- ***Transmutation Systems Studies developed as planned***
  - ***Quantitative Objectives and Criteria***
  - ***Transmutation Options***
  - ***Transmutation Analyses***
- ***Broad Systems Studies initiated***

Generation IV Activities being coordinated with AFCI:

- ***Economics and Proliferation Resistance & Physical Protection Evaluation Methodology Working Groups Formed***
- ***First year of System Preconceptual Design Studies***

Accomplishments in Systems Analysis

Developed a systematic understanding of the capability of reactor systems to handle transmutation:

- ***Deep burn of Pu in LWR's***
- ***Potential for burning Minor Actinides in LWR's***
- ***Transuranic burning in Fast Reactors and ADS's***

Developed initial quantitative assessments of repository benefits

- ***Heat load***
- ***Dose and radiotoxicity***

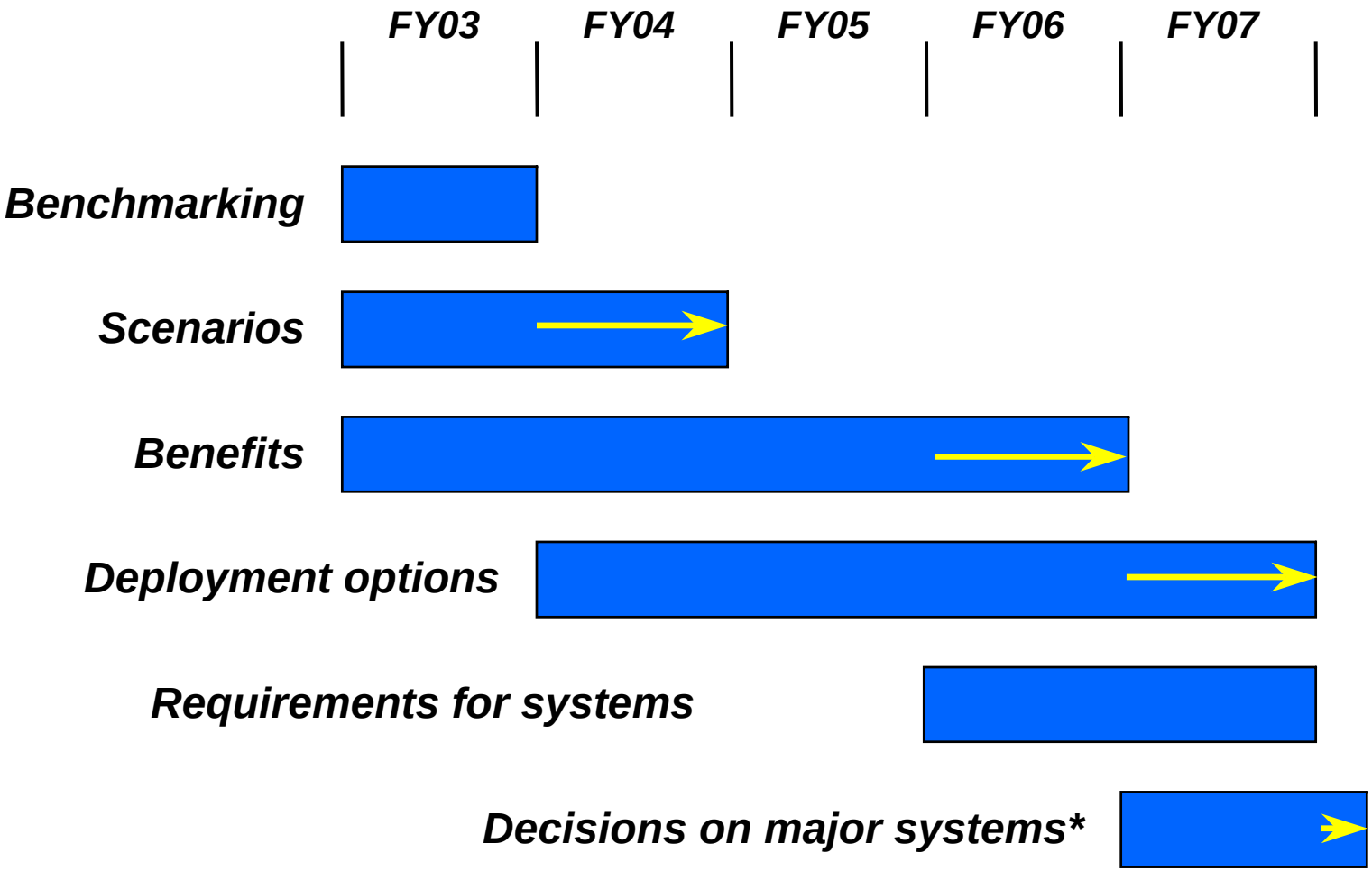
Refined the definition of the reference flowsheet

- ***Preferred pathways (storage or transmutation) for key elements***
- ***Technical criteria for each technology***

Initiated the development of quantified systems objectives

- ***Dynamic simulations to quantify infrastructure requirements***

Five-Year Overview of Systems Analysis



** Currently aimed at December 2007*

MIT Report Conclusions (wrt DOE NE)

Areas of Good Agreement

- ***Nuclear power should remain a long-term option for the U.S. energy supply, and requires a bold approach to overcoming the major issues (of waste, economics, safety)***
- ***NP 2010 should be supported, and 'first mover' plants should be strongly encouraged***
- ***Growth in nuclear energy will drive the need for expanded/improved means of dealing with waste***
- ***Advanced fuel cycle systems need to be rigorously studied, and reliable engineering data must support the analyses***
- ***HTGR should be developed***

MIT Report Conclusions (wrt DOE NE)

Areas of Disagreement

- ***How to make nuclear power economically competitive (subsidies, loan guarantees, technology improvements)***
- ***The potential of nuclear generated hydrogen to make a significant contribution to climate change***
- ***Costs, safety, waste impacts and proliferation resistance of current and advanced fuel cycles***
- ***Long-term use of the once-through fuel cycle with increased dependence on interim storage, to allow decades before decisions regarding deployment***
- ***Viability of deep borehole disposal***

MIT Report Conclusions

Recommendations Being Adopted in DOE NE Programs

- ***No large-scale demonstrations or deployment of advanced fuel cycle technology planned in the next decade***
- ***Increased emphasis on development of technology at laboratory scale***
- ***Broader R&D scope in separations, fuels and systems***
- ***Expansion of current scenarios of advanced and once-through fuel cycles***
- ***In-depth analysis of economics, safety, proliferation resistance and waste impacts***

Systems Analysis Directions in FY 2004

Continuing Transmutation Systems Studies

- ***Expanding the fuel cycle analyses to support economics, safety, nonproliferation and waste impacts***
- ***Emphasizing the time dependence to examine 'transition' from current to future states***

Ramping Up Broad Systems Studies

- ***Defining a manageable set spanning wide variety of options and uncertainties***
- ***Emphasizing the analysis of sustainability, economics, safety, nonproliferation and waste impacts***
- ***Developing criteria and metrics more fully***
- ***Starting to address deployment timing, siting, transportation***
- ***Interfacing with our well-developed analysis capabilities***
- ***Collaborating with DOE RW***
- ***Evaluating tradeoffs and providing feedback to AFCI R&D planning***

Integrating Generation IV and AFCI

- ***Common goals, objectives, measures and requirements***
- ***Integrated activities and organization***

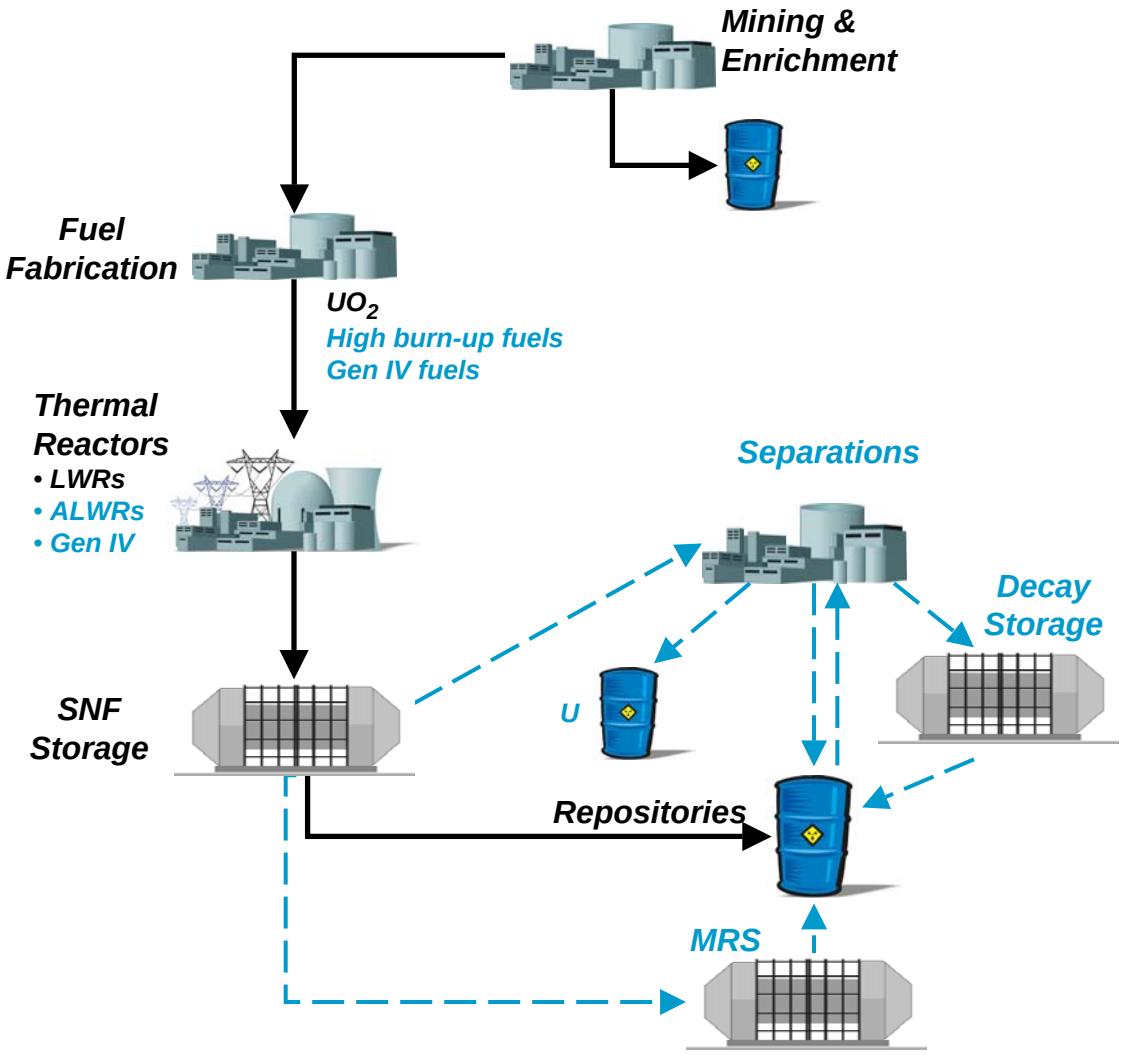
Systems Analysis Deliverables

FY 2004	***Initial report on repository benefits and options***
FY 2005	***Initial report on the key benefits and technology needs of an advanced fuel cycle for the U.S.***
FY 2005	***Initial report on advanced fuel cycle deployment options, including cost/benefit analysis***
FY 2005	***Initial report on requirements of the Generation IV systems needing advanced fuel cycle development***
FY 2005	***Initial report on fast spectrum transmutation options, including Generation IV and any other needed options***
FY 2006	***Interim report on advanced fuel cycle deployment options, including cost benefit analysis, and report on progress and comparative merits of alternative reprocessing technologies***
FY 2007	***Provide necessary information for a Dec 2007 Secretarial recommendation on the need for a second repository with a final report on a recommended US transmutation approach addressing options on the path, or paths, forward***

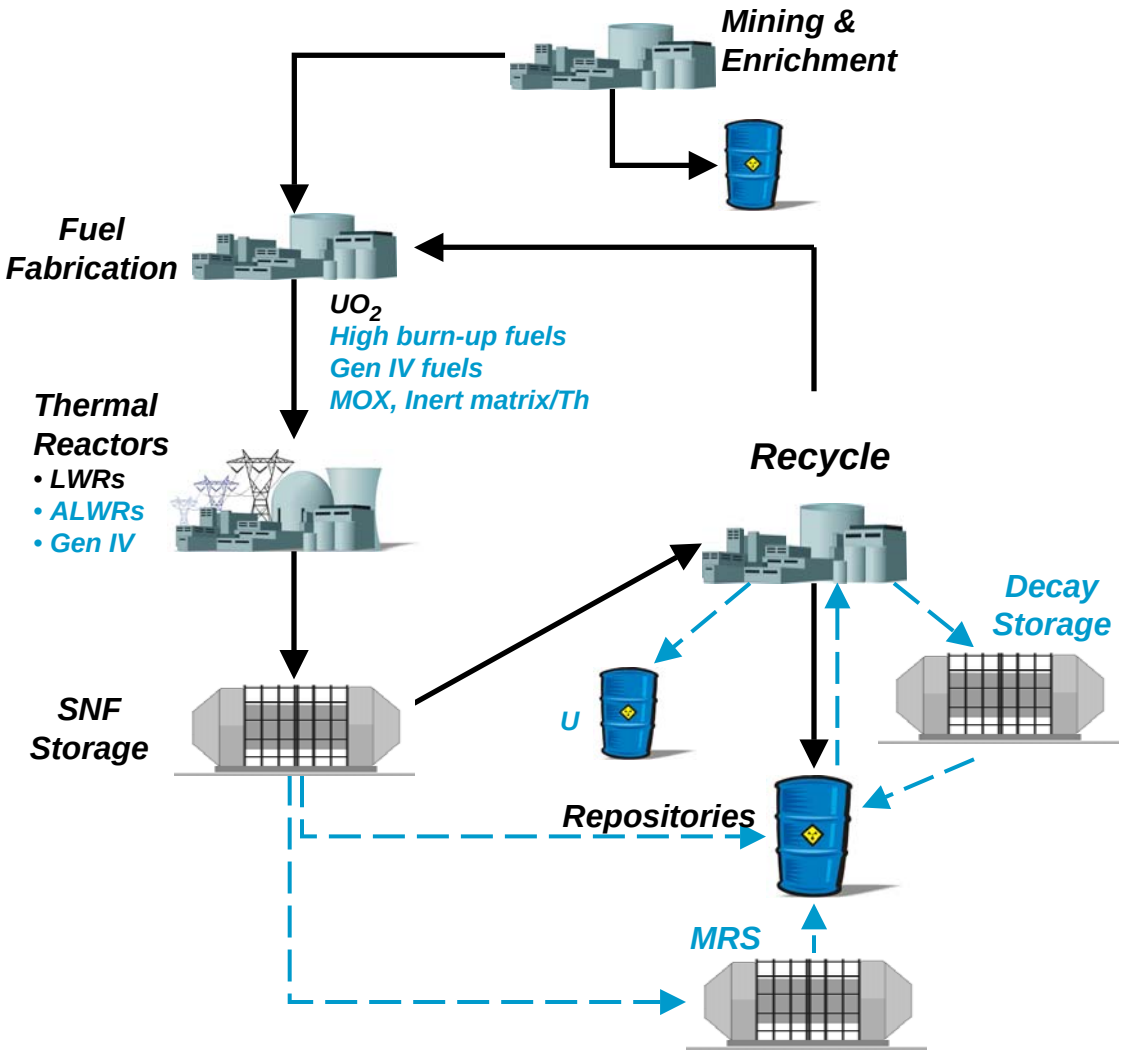
AFC Scenarios – Three Main Groups

1. *Thermal Once-Through (with expanded options)*
   - *No-growth, moderate growth*
   - *Interim storage*
   - *Separations, alternative disposal, decay storage*
   - *Gas reactors, hydrogen growth*
   - *Advanced LWR fuels*
   - *Long-term repository options*
2. *Thermal Recycle (with expanded options)*
3. *Thermal and Fast Recycle*

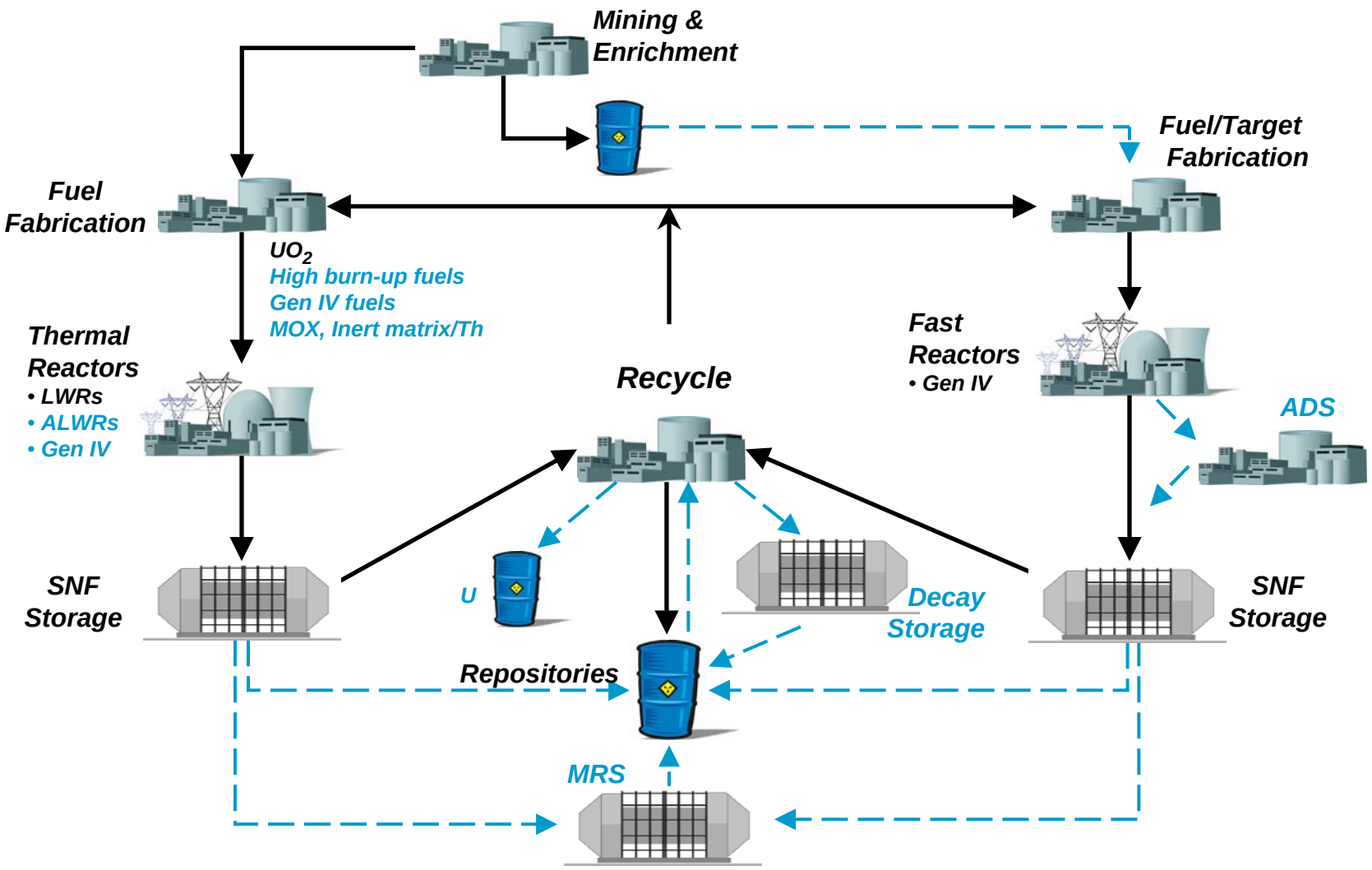
1) Thermal Once-Through



2) Thermal Recycle

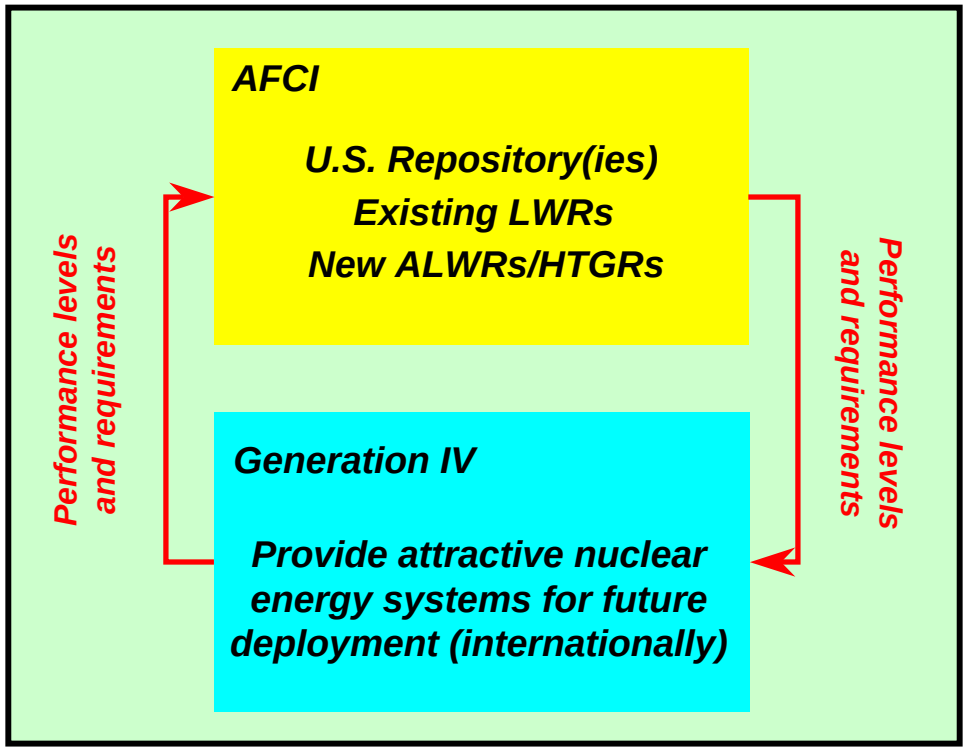


3) Thermal and Fast Recycle



Integrating the Programs

Establish nuclear power as a sustainable energy option, addressing long-term energy and environmental security, safety and reliability, Proliferation and economic concerns



Future U.S. Nuclear Fuel Cycle

Optimal deployment with time

Summary

- ***The major objective is a future, integrated, sustainable fuel cycle with waste management, economics, safety and proliferation resistance drivers, and which transitions from the current situation in the U.S. to meet future needs***
- ***Special emphasis will be placed on systems analysis to quantify performance***
- ***Requirements on AFCI and Generation IV systems will be integrated***
- ***Opportunities for shared or common activities between the programs will be exploited***